Energy Management Library V2.0

Unity Pro Components
User Manual

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All pertinent state, regional, and local safety regulations must be observed when installing and using this product. For reasons of safety and to help ensure compliance with documented system data, only the manufacturer should perform repairs to components.

When devices are used for applications with technical safety requirements, the relevant instructions must be followed.

Failure to use Schneider Electric software or approved software with our hardware products may result in injury, harm, or improper operating results.

Failure to observe this information can result in injury or equipment damage.

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Safety Information

Important Information

NOTICE

Read these instructions carefully, and look at the equipment to become familiar with the device before trying to install, operate, or maintain it. The following special messages may appear throughout this documentation or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.



The addition of this symbol to a “Danger” or “Warning” safety label indicates that an electrical hazard exists which will result in personal injury if the instructions are not followed.



This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

⚠ DANGER

DANGER indicates a hazardous situation which, if not avoided, **will result in** death or serious injury.

⚠ WARNING

WARNING indicates a hazardous situation which, if not avoided, **could result in** death or serious injury.

⚠ CAUTION

CAUTION indicates a hazardous situation which, if not avoided, **could result** in minor or moderate injury.

NOTICE

NOTICE is used to address practices not related to physical injury.

PLEASE NOTE

Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this material.

A qualified person is one who has skills and knowledge related to the construction and operation of electrical equipment and its installation, and has received safety training to recognize and avoid the hazards involved.

BEFORE YOU BEGIN

Do not use this product on machinery lacking effective point-of-operation guarding. Lack of effective point-of-operation guarding on a machine can result in serious injury to the operator of that machine.

⚠ WARNING

UNGUARDED EQUIPMENT

- Do not use this software and related automation equipment on equipment which does not have point-of-operation protection.
- Do not reach into machinery during operation.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

This automation equipment and related software is used to control a variety of industrial processes. The type or model of automation equipment suitable for each application will vary depending on factors such as the control function required, degree of protection required, production methods, unusual conditions, government regulations, etc. In some applications, more than one processor may be required, as when backup redundancy is needed.

Only you, the user, machine builder or system integrator can be aware of all the conditions and factors present during setup, operation, and maintenance of the machine and, therefore, can determine the automation equipment and the related safeties and interlocks which can be properly used. When selecting automation and control equipment and related software for a particular application, you should refer to the applicable local and national standards and regulations. The National Safety Council's Accident Prevention Manual (nationally recognized in the United States of America) also provides much useful information.

In some applications, such as packaging machinery, additional operator protection such as point-of-operation guarding must be provided. This is necessary if the operator's hands and other parts of the body are free to enter the pinch points or other hazardous areas and serious injury can occur. Software products alone cannot protect an operator from injury. For this reason the software cannot be substituted for or take the place of point-of-operation protection.

Ensure that appropriate safeties and mechanical/electrical interlocks related to point-of-operation protection have been installed and are operational before placing the equipment into service. All interlocks and safeties related to point-of-operation protection must be coordinated with the related automation equipment and software programming.

NOTE: Coordination of safeties and mechanical/electrical interlocks for point-of-operation protection is outside the scope of the Function Block Library, System User Guide, or other implementation referenced in this documentation.

START-UP AND TEST

Before using electrical control and automation equipment for regular operation after installation, the system should be given a start-up test by qualified personnel to verify correct operation of the equipment. It is important that arrangements for such a check be made and that enough time is allowed to perform complete and satisfactory testing.

⚠ CAUTION

EQUIPMENT OPERATION HAZARD

- Verify that all installation and set up procedures have been completed.
- Before operational tests are performed, remove all blocks or other temporary holding means used for shipment from all component devices.
- Remove tools, meters, and debris from equipment.

Failure to follow these instructions can result in injury or equipment damage.

Follow all start-up tests recommended in the equipment documentation. Store all equipment documentation for future references.

Software testing must be done in both simulated and real environments.

Verify that the completed system is free from all short circuits and temporary grounds that are not installed according to local regulations (according to the National Electrical Code in the U.S.A, for instance). If high-potential voltage testing is necessary, follow recommendations in equipment documentation to prevent accidental equipment damage.

Before energizing equipment:

- Remove tools, meters, and debris from equipment.
- Close the equipment enclosure door.
- Remove all temporary grounds from incoming power lines.
- Perform all start-up tests recommended by the manufacturer.

OPERATION AND ADJUSTMENTS

The following precautions are from the NEMA Standards Publication ICS 7.1-1995 (English version prevails):

- Regardless of the care exercised in the design and manufacture of equipment or in the selection and ratings of components, there are hazards that can be encountered if such equipment is improperly operated.
- It is sometimes possible to misadjust the equipment and thus produce unsatisfactory or unsafe operation. Always use the manufacturer's instructions as a guide for functional adjustments. Personnel who have access to these adjustments should be familiar with the equipment manufacturer's instructions and the machinery used with the electrical equipment.
- Only those operational adjustments actually required by the operator should be accessible to the operator. Access to other controls should be restricted to prevent unauthorized changes in operating characteristics.

About the Book

At a Glance

Document Scope

This document provides information on operating a project developed with PlantStruxure and the Energy Management library.

This document does not cover any development procedures and internal functionality details.

Users of the Unity Pro components should have a good working knowledge in the employment of the Unity Pro.

Validity Note

This document has been updated with the release of the Energy Management library V2.0.

Related Documents

Title of Documentation	Reference Number
Energy Management Library V2.0 Vijeo Citect Components User Manual	EIO0000001982

You can download these technical publications and other technical information from our website at www.schneider-electric.com.

Product Related Information

⚠ WARNING

LOSS OF CONTROL

Review potential failure modes of the control paths for critical control functions.

Provide a means to achieve a safe state during and after a path failure.

Provide separate or redundant control paths for critical control functions.

Review the implications of transmission delays or failure of communication links.

Apply local accident prevention and safety regulations and guidelines. [1]

Test each implementation of this library for proper operation before placing it into service.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

[1] For additional information, refer to NEMA ICS 1.1 (latest edition), Safety Guidelines for the Application, Installation, and Maintenance of Solid State Control and to NEMA ICS 7.1 (latest edition), Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable-Speed Drive Systems or their equivalent governing your particular location.

The application of this product requires expertise in the design and operation of control systems.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

Allow only authorized personnel with such expertise to program, install, alter, and apply this product.

Follow local and national safety codes and standards.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Examples in this manual are given for information only.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

Adapt examples that are given in this manual to the specific functions and safety requirements of your industrial application when you implement them.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Chapter 1
Particular Requirements

Providing Appropriate Input Values

Scaling

You have to verify that the inputs of the library blocks adhere to the exact scaling factor used in the devices from which they are measured.

Accuracy

You have to verify that the inputs to the library blocks have high accuracy (provide values with at least 2 decimal places).

Chapter 2
Aggregator DFB

Overview

This chapter describes the `Aggregator` DFB.

The function block does not reflect any specific installation.

⚠ WARNING

MISAPPLICATION OF FUNCTION BLOCKS

Before adopting these function blocks for use in a specific application, you must:

- Conduct a safety analysis for the application and equipment installed.
- Verify that the selected function blocks are appropriate for the equipment or function in the installation.
- Supply appropriate parameters, particularly for limits.
- Check that all sensors and actuators are compatible with the selected function blocks.
- Verify that all functions of the selected function blocks work properly during verification and commissioning.
- Provide independent paths for critical control functions (emergency stop, over-limit conditions, etc.) according to the safety analysis and applicable codes, and regulations.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

What Is in This Chapter?

This chapter contains the following topics:

Topic	Page
Overview	16
DFB Representation	18
Outputs	19
Inputs/Outputs	20
Public Variables	22

Overview

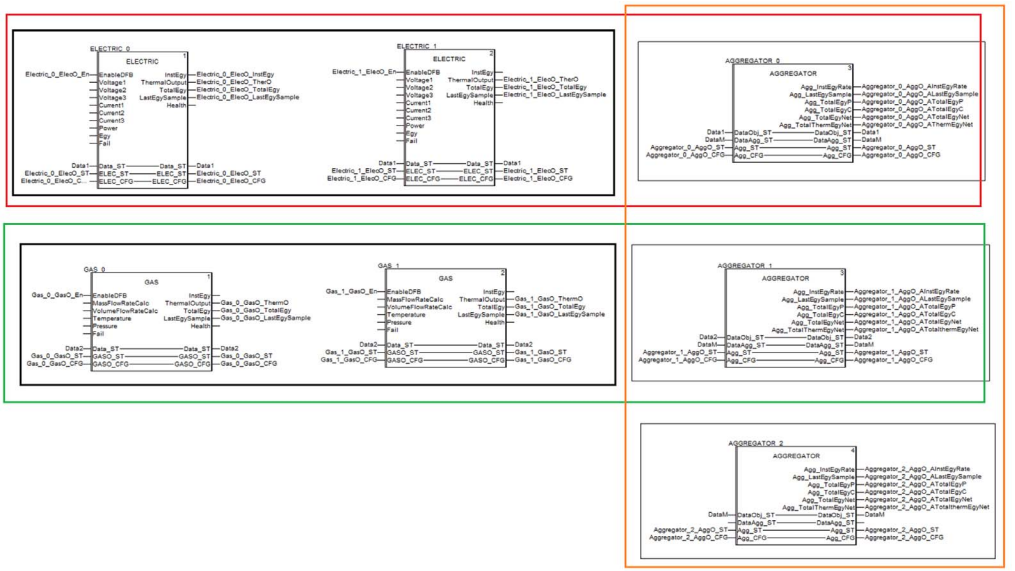
Description

The `Aggregator` block is used to aggregate energy (in kWh) at several levels for the user to view the collective energy consumption of a plant.

The use cases of the `Aggregator` block are as follows:

- The aggregation of energy from two `Electric` blocks is shown with the red outline
- The aggregation energy from two `Gas` blocks is shown with the green outline.
- The aggregation of energy from two independent `Aggregator` blocks is shown in the black outline.
- The aggregation of energies from any two energy blocks.

The following figure shows the use cases of the `Aggregator` block:



The link between the blocks is through the `Data_ST` and `DataAgg` derived data type (DDT). To connect the blocks to the `Aggregator`, you have to connect them through `Data_ST` DDT. To connect two or more `Aggregator` blocks, you have to connect them through the `DataAgg` DDT.

The `Aggregator` block provides the following types of information:

1. The aggregated instantaneous of energy (kW) value in order to determine the energy rate of the plant/section/area at any particular time
2. The aggregated energy produced/consumed in the past sample time. You can select the sample time. For example, if you input 15 minutes as sample time, the block will calculate the energy produced/consumed for this period and the value is checked and revised every minute.
3. The total energy produced by the blocks that are configured as producers.

4. The total energy consumed by the blocks that are configured as consumers.
5. The total aggregated energy value. The total energy consumed (kWh) is the total energy consumed by the plant/section/area from the start of the controller execution.

NOTE: For successful aggregation of energy values by the aggregator, confirm that the aggregator is executed after the energy blocks connected to it:

- Electrical/non-electrical block
- Aggregator block

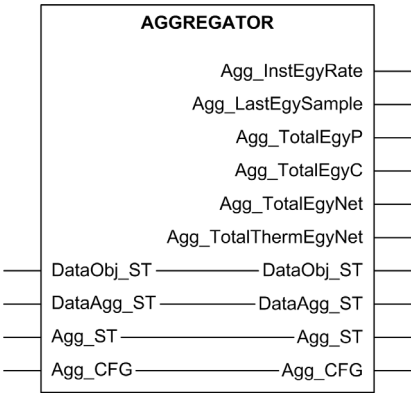
NOTE: In case of aggregation of aggregator, the execution order should be:

- Electrical/non-electrical aggregators
- Aggregator block

DFB Representation

Representation

The following figure represents the AGGREGATOR DFB.



Outputs

Output Parameter Description

Parameter	Type	Description
Agg_InstEgyRate	REAL	The totalized instantaneous energy value in kW.
Agg_LastEgySample	ARRAY [0...4] OF INT	The last energy sample value in Wh.
Agg_TotalEgyP	ARRAY [0...4] OF INT	The totalized energy value produced in Wh.
Agg_TotalEgyC	ARRAY [0...4] OF INT	The totalized energy value consumed in Wh.
Agg_TotalEgyNet	ARRAY [0...4] OF INT	The net totalized energy value in Wh.
Agg_TotalThermalNet	ARRAY [0...4] OF INT	The net totalized energy value in local units.

Inputs/Outputs

Input/Output Parameter Description

Parameter	Type	Description
DataObj_ST	DATA_ST_DDT *(see page 20)*	This DDT pin is connected to the slave objects for aggregating its energy at the first level.
DataAgg_ST	DATA_ST_DDT *(see page 20)*	This DDT pin is connected to the higher-level Aggregator blocks for aggregation at higher levels.
Agg_ST	AGG_ST_DDT *(see page 21)*	This is used for communication with the Vijeo Citect components.
Agg_CFG	AGG_CFG_DDT *(see page 21)*	This is the additional information for communication with the Vijeo Citect components.

DATA_ST_DDT

This structure contains the energy to be transferred for aggregation:

Parameter	Type	Description
EgyInstP	REAL	Total instantaneous energy from producers
EgyInstC	REAL	Total instantaneous energy from consumers
EgySamplePDint	DINT	Sample energy produced
EgyTotalPDint	DINT	Total energy produced
EgySampleCDint	DINT	Sample energy consumed
EgyTotalCDint	DINT	Total energy consumed
ThermalEgyTotalPDint	DINT	Thermal energy produced
ThermalEgyTotalCDint	DINT	Thermal energy consumed
SampleT	TIME	Sample time
EgySampleP	ARRAY [0..4] OF INT	Total sample energy from producers
EgySampleC	ARRAY [0..4] OF INT	Total sample energy from consumers
EgyTotalP	ARRAY [0..4] OF INT	Total energy from producers
EgyTotalC	ARRAY [0..4] OF INT	Total energy from consumers
ThermalEgyTotalP	ARRAY [0..4] OF INT	Total thermal energy from producers
ThermalEgyTotalC	ARRAY [0..4] OF INT	Total thermal energy from consumers
Health	BOOL	Health bit
Reserved	INT	Reserved

AGG_ST_DDT

This structure contains the block control and status data:

Parameter	Type	Description
NetSampleEgyDint	DINT	Net sample energy
NetEgyPDint	DINT	Net total energy produced
NetEgyCDint	DINT	Net total energy consumed
NetEgyDint	DINT	Net total energy
NetThermalEgyDint	DINT	Net thermal energy
STW	WORD	Status word
Reserved	INT	Reserved

AGG_CFG_DDT

This structure contains the additional status data:

Parameter	Type	Description
NetInstRate	REAL	Net instantaneous rate
NetSampleEgy	ARRAY [0..4] OF INT	Net sample energy
NetEgyP	ARRAY [0..4] OF INT	Net energy from producers
NetEgyC	ARRAY [0..4] OF INT	Net energy from consumers
NetEgy	ARRAY [0..4] OF INT	Net energy
NetThermalEgy	ARRAY [0..4] OF INT	Net thermal energy
Reserved	INT	Reserved

Public Variables

Public Variable Description

Variable	Type	Description
SampleT	TIME	Sample time
ThermalUnit	BYTE	The unit of the thermal energy derived in: ● 0 - kcal ● 1 - BTU ● 2 - Therms
Reserved	INT	Reserved
SC	AGG_SC_DDT *(see page 22)*	Provides frequently needed data to monitor

AGG_SC_DDT

Provides the frequently needed data to monitor:

Parameter	Type	Description
NetInstEgy	REAL	Net instantaneous rate
TotalEgyNet	ARRAY [0..4] OF INT	Net total energy
AHH	BOOL	High-high level alarm
AH	BOOL	High level alarm
AD	BOOL	Deviation alarm
AL	BOOL	Low-level alarm
ALL	BOOL	Low-low level alarm

Chapter 3
Gas Energy DFB

Overview

This chapter describes the `Gas` DFB.

The function block does not reflect any specific installation.

⚠ WARNING

MISAPPLICATION OF FUNCTION BLOCKS

Before adopting these function blocks for use in a specific application, you must:

- Conduct a safety analysis for the application and equipment installed.
- Verify that the selected function blocks are appropriate for the equipment or function in the installation.
- Supply appropriate parameters, particularly for limits.
- Check that all sensors and actuators are compatible with the selected function blocks.
- Verify that all functions of the selected function blocks work properly during verification and commissioning.
- Provide independent paths for critical control functions (emergency stop, over-limit conditions, etc.) according to the safety analysis and applicable codes, and regulations.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

What Is in This Chapter?

This chapter contains the following topics:

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Inputs/Outputs	29
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Overview

Information Provided by the Block

The `Gas` block provides the following types of information:

1. The instantaneous energy (kW) value in order to determine the energy rate of the `Gas` block at any particular time.
2. The energy produced/consumed in the past sample time. You can select the sample time. For example, if you input 15 minutes as sample time, the block will calculate the energy produced/consumed in this period and the value is checked and revised every minute. This value has to be entered from the public variable of the DFB at the start of program execution.
3. The total energy value is the total energy consumed (kWh) by the plant/section/area from the start of the controller execution. You can reset this value and this does not affect the `Aggregator` calculation.
4. The instantaneous thermal output in local units.

Working Principle

- The `Gas` DFB takes input in the form of mass or volume of gas with a specific calorific value and physical properties to provide an energy output.
- Volumetric flow measurement and Mass flow measurement are the two methods by which the gas quantity can be measured with the flow meters and the DFB is designed only to receive either of these measurement signals. Therefore, you need to configure either mass flow rate or volumetric flow rate. As volumetric flow measurement is commonly used in industry, it is considered as the default value. The input from the field is connected to respective pins such as mass flow rate or volume flow rate.

Implementation

- For input values such as mass and volume flow, pressure and temperature are first scaled through an analog input block and then passed to the `Gas` block.
- The threshold of these values are in the analog input itself, where these thresholds, (high-high, high, low, and low-low) are available. These alert indications are shown in Supervision Control and Data Acquisition (SCADA).
- You need to configure respective units of these input parameters for appropriate conversion in the public variables.
- You can make a table to refer the calorific values as this values are constant. The calorific value and density of the gas are entered in the public variable of the DFB.

Volumetric Flow Measurement Method

- If Energy is measured with volume flow meter, the volume values obtained is under one of the following categories:

  1. Direct value from field = (m^3/hr)
  2. STP (Standard Temperature, Pressure) = 1 bar, 273 Kelvin
  3. NTP (Normal Temperature, Pressure) = 1 Atmosphere and 298 Kelvin

  You have to enter the temperature and pressure values.
- Actual Flow rate = ((Pnorm * Vnorm)/Tnorm) * (Tactual/Pactual).
  You can enter Pnorm and Tnorm either at the pin or set to the default value based on NTP or STP.
- For calculation of volumetric flow of gas, density parameter is required. For density, either you can make a table to refer for known gas (in form of public variable) or derive the value from the formula given below.
- Density = (Pactual * M)/(R * Tactual).
  Where M = Molecular weight of gas and R = gas constant

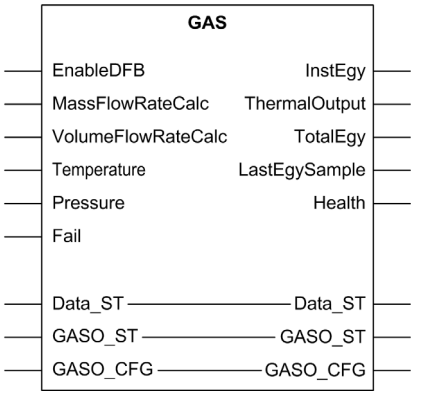
Mass Flow Measurement Method

- If Energy is measured with mass flow meter, mass flow meter gives the value in terms of mass flow rate (kg/hr). The amount of gas (energy consumed) with respect to mass flow rate is calculated as:
  Energy (kWh) = CV * Mass flow rate = kcal/kg * kg/hr = kcal/hr
- Mass flow rate is calculated as Va * Actual Density (kg/hr)
- Final energy consumed in terms of volume is calculated again using the formula:
  Energy = CV * Mass flow rate= kcal/kg * kg/hr = kcal/hr = kWh.

DFB Representation

Representation

The following figure represents the `Gas` DFB:



Inputs

Input Parameter Description

Parameter	Type	Description
EnableDFB	BOOL	Enables the DFB.
MassFlowRateCalc	REAL	Calculated mass flow rate value received from mass flow meter.
VolumeFlowRateCalc	REAL	Calculated volumetric flow rate value received from the volumetric flow meter.
Temperature	REAL	Temperature of the gas measured from the field.
Pressure	REAL	Pressure of the gas measured from the field.
Fail	BOOL	Any detected failure that is linked to this block. This input will come from a CONDSUM block.

Outputs

Output Parameter Description

Parameter	Type	Description
`InstEgy`	REAL	Instantaneous energy rate in kW. In order to be in line with the ODVA standards, the instantaneous energy value should not exceed 32767 kW.
`ThermalOutput`	ARRAY [0...4] OF INT	Instantaneous energy in local units.
`TotalEgy`	ARRAY [0...4] OF INT	Total energy consumed in Wh.
`LastEgySample`	ARRAY [0...4] OF INT	Energy consumed in the last sample time in Wh.
`Health`	BOOL	Indicates the health of the block: • `Health` = 0: energy of the block is not aggregated. • `Health` = 1: energy of the block is aggregated.

Inputs/Outputs

Input/Output Parameter Description

Parameter	Type	Description
Data_ST	DATA_ST_DDT *(see page 29)*	This DDT pin is connected between the DFB and the Aggregator block, for aggregation of energy values.
GasO_ST	STATUS_ST_DDT *(see page 29)*	This is the primary variable used for communication with the Vijeo Citect components.
GasO_CFG	GAS_CFG_DDT *(see page 29)*	This is the secondary variable used for communication with the Vijeo Citect components.

DATA_ST_DDT

This structure contains the data to be aggregated from the Gas block. Refer to DATA_ST_DDT *(see page 20)*.

STATUS_ST_DDT

This structure contains the block control and status data:

Parameter	Type	Description
InstEgy	REAL	Instantaneous energy.
TotalEgyDint	DINT	Total energy in Wh. This is used for trend tags.
ThermalOutputDint	DINT	Total energy value in local units for trend tags.
LastEgySampleDint	DINT	Last energy values for the set sample time. This information is used for trend tags.
STW	WORD	Status word.
CFGW	WORD	Configuration word.

GAS_CFG_DDT

This structure contains the additional status data:

Parameter	Type	Description
Temperature	REAL	Temperature of the gas input
Density	REAL	Density of the gas input
CalorificValue	REAL	Calorific value entered by the user
Pressure	REAL	Pressure of the gas input
MFR	REAL	Mass flow rate
VFR	REAL	Volumetric flow rate

Parameter	Type	Description
ThermOP	ARRAY [0..4] OF INT	Instantaneous thermal energy
SampleEgy	ARRAY [0..4] OF INT	Sample energy
TotalEgy	ARRAY [0..4] OF INT	Total energy
ThermalUnit	BYTE	The unit of the thermal energy derived in: ● 0 - kcal ● 1 - BTU ● 2 - Therms
Reserved	BYTE	Reserved

STW- Status Word

Bit Structure of STW - Status Word:

Bit	Description
0	Detected failure: ● 0 - No detected failure ● 1 - Detected failure
1	Energy type: ● 0 - Producer ● 1 - Consumer
2...15	Reserved

CFGW - Configuration Word

Bit Structure of CFGW - Configuration Word:

Bit	Description
0	Reset energy - Detected by level
1...15	Reserved

Public Variables

Public Variable Description

Variable	Type	Description
`CalorificValue`	REAL	Specify the calorific value of the fuel in kcal/kg.
`TempNorm`	REAL	Normal temperature. Default value is 298 K.
`PressureNorm`	REAL	Normal pressure. Default value is 1 bar.
`Density`	REAL	Specify the density of the gas in m^3/kg.
`ScanRate`	TIME	Specify the time interval desired to perform energy aggregation.
`SampleT`	TIME	Specify the time interval desired to take Energy samples.
`Reset`	UINT	1 - To reset the totalized energy value.
`ResetEnable`	BOOL	Reset: ● 0 - Disable reset ● 1 - Enable reset
`Etype`	BOOL	Energy type: ● 0 - Block is producer ● 1 - Block is consumer
`ThermalOutputUnit`	BYTE	The unit of the thermal energy derived in: ● 0 - kcal ● 1 - BTU ● 2 - Therms
`TempUnit`	BYTE	The unit of the temperature measured in: ● 0 - Kelvin ● 1 - Celsius ● 2 - Fahrenheit
`PressureUnit`	BYTE	The unit of the pressure measured in: ● 0 - bar ● 1 - Atm ● 2 - Kpa ● 3 - kg/cm^2
`MassFlowUnit`	BYTE	The unit of the mass flow measured in: ● 0 - kg/hr ● 1 - gm/hr ● 2 - tonne/hr

Variable	Type	Description
VolumeFlowUnit	BYTE	The unit of the volume flow measured in: ● 0 - m3/hr ● 1 - cf/hr ● 2 - ccf/hr ● 3 - mcf/hr ● 4 - litres/hr
Reserved	INT	Reserved.
SC	SEQ_SC_DDT *(see page 32)*	Provides the frequently needed data to monitor.

SEQ_SC_DDT

This structure contains the additional status data:

Parameter	Type	Description
InstEgy	REAL	Instantaneous energy
TotalEgy	ARRAY [0..4] OF INT	Total energy
Health	BOOL	Health status
EType	BOOL	Energy type
AHH	BOOL	High-high level alarm
AH	BOOL	High level alarm
AD	BOOL	Deviation alarm
AL	BOOL	Low level alarm
ALL	BOOL	Low-low level alarm
Reserved	INT	Reserved

Chapter 4
Voltage/Current and Power Electrical DFB

Overview

This chapter describes the `Electric` DFB.

The function block does not reflect any specific installation.

⚠ WARNING

MISAPPLICATION OF FUNCTION BLOCKS

Before adopting these function blocks for use in a specific application, you must:

- Conduct a safety analysis for the application and equipment installed.
- Verify that the selected function blocks are appropriate for the equipment or function in the installation.
- Supply appropriate parameters, particularly for limits.
- Check that all sensors and actuators are compatible with the selected function blocks.
- Verify that all functions of the selected function blocks work properly during verification and commissioning.
- Provide independent paths for critical control functions (emergency stop, over-limit conditions, etc.) according to the safety analysis and applicable codes, and regulations.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

What Is in This Chapter?

This chapter contains the following topics:

Topic	Page
Overview	34
DFB Representation	35
Inputs	36
Outputs	37
Inputs/Outputs	38
Public Variables	40
Technical Implementation/Methodology	42

Overview

Information Provided by the Block

The `Electric` block provides the following types of information:

1. The instantaneous energy (kW) value in order to determine the energy rate of the Electrical object at any time.
2. The energy produced/consumed in the past sample time. You can select the sample time. For example, if you input 15 minutes as sample time, the block will calculate the energy produced/consumed for this period and this value is checked and revised every minute. The sample time is set from the public variable of the DFB at the start of program execution.
3. The total energy value is the total energy consumed (kWh) by the plant/section/area from the start of the controller execution. You can reset and this will not affect the `Aggregator` calculation.
4. The instantaneous thermal output in local units.

Working Principle

This block takes the electrical inputs from measuring devices pertaining to particular equipment.

Implementation

- The input can be in the form of the voltage and current or the power/energy and are provided to the block through an analog input block.
- The threshold of these values are in the analog input itself, where these thresholds (high-high, high, low, and low-low) are available. These alert indications are shown in SCADA.

Single Phase or Three-Phase Input

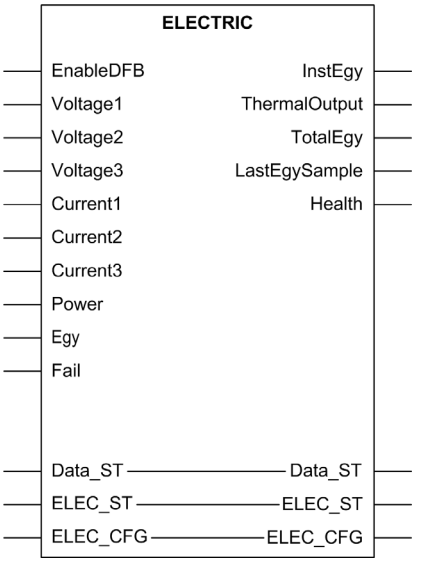
A single DFB has the flexibility to receive inputs in the form of single phase or three-phase voltage and current or single phase and three-phase power/energy:

- If single phase energy is desired, connect the inputs `Voltage1` and `Current1`, `Power` or energy.
- If three-phase energy is desired, connect the inputs `Voltage1`, `Voltage2`, `Voltage3`, and `Current1`, `Current2`, `Current3`, and PF, or `Power` and PF, or Energy and PF.

DFB Representation

Representation

The following figure represents the `Electric` DFB:



Inputs

Input Parameter Description

Parameter	Type	Description
EnableDFB	BOOL	Enables the DFB.
Voltage1	REAL	When the mode selected is 0, this pin is used to enter the voltage value. When the mode selected is 1, the phase 1 voltage measured from the measuring device is connected.
Voltage2	REAL	Phase 2 voltage measured from the measuring device.
Voltage3	REAL	Phase 3 voltage measured from the measuring device.
Current1	REAL	When the mode selected is 0, this pin is used to enter the single phase current value. When the mode selected is 1, the phase 1 current measured from the measuring device is connected.
Current2	REAL	Phase 2 line current measured from the measuring device.
Current3	REAL	Phase 3 line current measured from the measuring device.
Power	REAL	When the mode is 0, this pin is used to connect the single phase active power value. When the mode is 1, this pin is used to connect the active power input.
Egy	Real	When the mode is 0, this pin is used to connect the single phase energy value. When the mode is 1, this pin is used to connect the apparent energy input.
Fail	BOOL	Any detected failure that is linked to this block. This input will come from a CONDSUM block.

Outputs

Output Parameter Description

Parameter	Type	Description
`InstEgy`	REAL	Instantaneous energy rate in kW. In order to be in line with the ODVA standards, the instantaneous energy value should not exceed 32767 kW.
`ThermalOutput`	ARRAY [0...4] OF INT	Instantaneous thermal energy in local units.
`TotalEgy`	ARRAY [0...4] OF INT	Total energy consumed in Wh.
`LastEgySample`	ARRAY [0...4] OF INT	Energy consumed in the last sample time in Wh.
`Health`	BOOL	Indicates the health of the block: • `Health` = 0: Energy of the block is not aggregated. • `Health` = 1: Energy of the block is aggregated.

Inputs/Outputs

Input/Output Parameter Description

Parameter	Type	Description
Data_ST	DATA_ST_DDT *(see page 38)*	This DDT pin is connected between the DFB and the Aggregator block, for aggregation of energy values.
Elec_ST	STATUS_ST_DDT *(see page 38)*	This is used for communication with Vijeo Citect components.
Elec_CFG	ELEC_CFG_DDT *(see page 39)*	This is the secondary variable used for communication with the Vijeo Citect components.

DATA_ST_DDT

This structure contains the data to be aggregated from the Electric block. Refer to DATA_ST_DDT *(see page 20)*.

STATUS_ST_DDT

This structure contains the block control and status data:

Parameter	Type	Description
InstEgy	REAL	Instantaneous energy
TotalEgyDint	DINT	Total energy in Wh. This is used for trend tags.
ThermalOutputDint	DINT	Total energy value in local units for trend tags.
LastEgySampleDint	DINT	Last energy values for the set sample time. This information is used for trend tags.
STW	WORD	Status word
CFGW	WORD	Configuration word

ELEC_CFG_DDT

This structure contains the block control and status data:

Parameter	Type	Description
VoltagePhase1	REAL	Phase 1 measured voltage
VoltagePhase2	REAL	Phase 2 measured voltage
VoltagePhase3	REAL	Phase 3 measured voltage
CurrentPhase1	REAL	Phase 1 measured current
CurrentPhase2	REAL	Phase 2 measured current
CurrentPhase3	REAL	Phase 3 measured current
PF	REAL	Power factor
SampleEgy	ARRAY [0..4] OF INT	Sample energy
ThermOP	ARRAY [0..4] OF INT	Instantaneous thermal energy
TotalEgy	ARRAY [0..4] OF INT	Total energy
Reserved	INT	Reserved

STW- Status Word

Bit Structure of STW - Status Word:

Bit	Description
0	Detected failure: ● 0 - No detected failure ● 1 - Detected failure
1	Energy type: ● 0 - Producer ● 1 - Consumer
2...15	Reserved

CFGW- Configuration Word

Bit Structure of CFGW - Configuration Word:

Bit	Description
0	Reset energy - Detected by level
1...15	Reserved

Public Variables

Public Variable Description

Variable	Type	Description
PF	REAL	Enter the power factor.
ScanRate	TIME	Specify the time interval desired to perform energy aggregation.
SampleT	TIME	This public variable is the interval at which the totalized energy is updated.
Reset	UINT	1 - To reset the totalized energy value.
ResetEnable	BOOL	Reset: ● 0 - Disable reset. ● 1 - Enable reset.
Etype	BOOL	Energy type: ● 0 - Block is producer. ● 1 - Block is consumer.
Mode	BYTE	User selection for: ● 0 - for single phase Voltage/Current/Power/Energy ● 1 - for 3-phase Voltage/ Current/Energy/Power
VUnit	BYTE	Unit of the voltage measured in: ● 0 - V ● 1 - mV ● 2 - kV
IUnit	BYTE	Unit of the current measured in: ● 0 - A ● 1 - mA ● 2 - µA
PUnit	BYTE	Unit of the power measured in: ● 0 - kW ● 1 - W
EUnit	BYTE	Unit of the Energy measured in: ● 0 - kWh ● 1 - Ws/J ● 1 - Wh ● 1 - kJ ● 1 - MJ ● 1 - GJ
SC	SEQ_SC_DDT *(see page 41)*	Provides the frequently needed data to monitor.

SEQ_SC_DDT

Provides the frequently needed data to monitor *(see page 32)*.

Technical Implementation/Methodology

Single Phase Current and Voltage Input To Energy (GJ)

Energy (kWh)= (Voltage * Current) * Sample Time * Power Factor = (volts*Amps*1sec)/3600 kWh

3-Phase Current and Voltage Input to Energy (GJ)

Energy (kWh)= $\sqrt{3}$ * Phase Voltage * Line Current * Power Factor * Sample Time = (Volts*Amps*1Sec) /3600 kWh

Phase Voltage = $(V_1 + V_2 + V_3)/3$

Line Current = $(I_1 + I_2 + I_3)/3$

Single Phase Power Input to Energy (GJ)

Energy (kWh) = Active Power * Sample Time = Watt*1Sec/3600 kWh

3-Phase Power input to Energy (GJ)

Energy (kWh) = Active Power * Sample Time = Watts*1Sec/3600

Single Phase Energy input to Energy (GJ)

Energy (kWh) = Watts * Power Factor/3600 kWh

3-Phase Apparent Energy input to Energy (GJ)

Energy (kWh) = Watts *Power Factor/3600 kWh

Chapter 5
Unit Conversion DFBs

Overview

This chapter describes the `UnitConv` DFBs.

The function blocks do not reflect any specific installation.

⚠ WARNING

MISAPPLICATION OF FUNCTION BLOCKS

Before adopting these function blocks for use in a specific application, you must:

- Conduct a safety analysis for the application and equipment installed.
- Verify that the selected function blocks are appropriate for the equipment or function in the installation.
- Supply appropriate parameters, particularly for limits.
- Check that all sensors and actuators are compatible with the selected function blocks.
- Verify that all functions of the selected function blocks work properly during verification and commissioning.
- Provide independent paths for critical control functions (emergency stop, over-limit conditions, etc.) according to the safety analysis and applicable codes, and regulations.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

What Is in This Chapter?

This chapter contains the following sections:

Section	Topic	Page
5.1	Unit Conversion Block - Non-electric Object	44
5.2	Unit Conversion Block - Electrical Object	49

Section 5.1
Unit Conversion Block - Non-electric Object

Overview

This section describes the unit conversion block for non-electric object.

What Is in This Section?

This section contains the following topics:

Topic	Page
Overview	45
DFB Representation	46
Inputs	47
Outputs	48

Overview

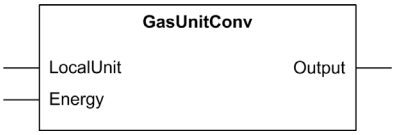
Description

The `UnitConv` block is used to convert the inputs of the block into the specified local unit. This block is used internally in the non-electrical object DFB like `Solid`, `Liquid`, `Gas`, and `Boiler`.

DFB Representation

Representation

The following figure represents the `UnitConv` DFB.



Inputs

Input Parameter Description

Parameter	Type	Description
`LocalUnit`	BYTE	Enumerations value provided by the user to convert the Watt hour inputs to the desired local value: ● 0: kcal ● 1: BTU (British Thermal Unit) ● 2: Thermal unit
`Energy`	REAL	Energy input (in kW) to the Block for conversion into the local unit.

Outputs

Output Parameter Description

Parameter	Type	Description
`Output`	REAL	Output of the block gives the energy in terms of the selected unit.

Section 5.2
Unit Conversion Block - Electrical Object

Overview

This Section describes the unit conversion block for Electrical objects.

What Is in This Section?

This section contains the following topics:

Topic	Page
Overview	50
DFB Representation	51
Inputs	52
Outputs	53

Overview

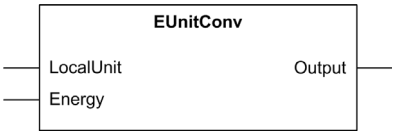
Description

The `EUnitConv` block is used to convert the inputs of the block into the specified local unit. This block is used internally in the `Electric` DFB.

DFB Representation

Representation

The following figure represents the `EUnitConv` DFB.



Inputs

Input Parameter Description

Parameter	Type	Description
`LocalUnit`	BYTE	Enumerations value provided by the user to convert the Watt Hour inputs to the desired local value: ● 0 : kW ● 1: kWh
`Energy`	REAL	Energy input (in kW) to the block for conversion into the local unit

Outputs

Output Parameter Description

Parameter	Type	Description
`Output`	REAL	Output of the block gives the energy in terms of the selected unit.

Chapter 6
Boiler DFB

Overview

This chapter describes the `Boiler` DFB.

The function block does not reflect any specific installation.

⚠ WARNING

MISAPPLICATION OF FUNCTION BLOCKS

Before adopting these function blocks for use in a specific application, you must:

- Conduct a safety analysis for the application and equipment installed.
- Verify that the selected function blocks are appropriate for the equipment or function in the installation.
- Supply appropriate parameters, particularly for limits.
- Check that all sensors and actuators are compatible with the selected function blocks.
- Verify that all functions of the selected function blocks work properly during verification and commissioning.
- Provide independent paths for critical control functions (emergency stop, over-limit conditions, etc.) according to the safety analysis and applicable codes, and regulations.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

What Is in This Chapter?

This chapter contains the following topics:

Topic	Page
Overview	56
DFB Representation	57
Inputs	58
Outputs	59
Inputs/Outputs	60
Public Variables	62

Overview

Description

The Boiler block is used to calculate the energy produced by a boiler. It takes input in the form of mass flow rate of feed water and the physical properties to provide an output, which can be used to determine the accumulation of energy in the form of generation.

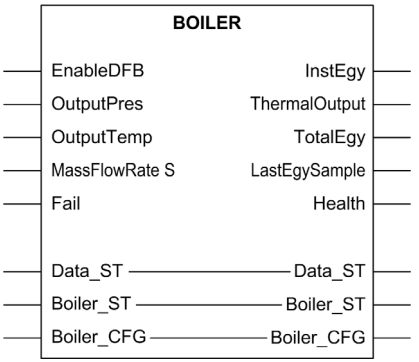
The functions of Boiler block are as follows:

- Enthalpy of steam and Feed water are the constants entered by the user into the public variables of the block. Steam quantity produced is measured with a mass flowmeter.
- For input values, output pressure, mass flow of steam and output temperature are first scaled through an analog input block and then is passed to the Boiler block.
- The threshold of these values is in the analog input, where these thresholds (high-high, high, low and low-low) are available. These alert indications are shown in SCADA.
- You need to configure the respective units of these input parameters for appropriate conversion.
- Mass flow meter gives the value in terms of mass flow rate (kg/hr). Amount of steam (energy produced) with regard to mass flow is calculated as:
  Energy = (Enthalpy of steam- Enthalpy of feedwater)* Mass Flow rate = kcal/kg x kg/hr = kcal/hr = kWh
- Totalized value at the set sample rate provides energy value at the output pin energy which is calculated using the following equation:
  Q = (Hs-Hw) x M, where:
  - Q = Energy or heat duty, kW
  - M = Mass, kg/hr
  - Hs = Enthalpy of steam , kcal/kg
  - Hw= Enthalpy of feed water, kcal/kg

DFB Representation

Representation

The following figure represents the `Boiler` DFB:



Inputs

Input Parameter Description

Parameter	Type	Description
EnableDFB	BOOL	Enables the DFB.
OutputPres	REAL	The pressure of the superheated steam output.
OutputTemp	REAL	The temperature of the superheated steam output.
MassFlowRateS	REAL	The mass flow rate of the output superheated steam is required to calculate the output energy of this steam generated.
Fail	BOOL	Any detected failure that is linked to this block. This input will come from a CONDSUM block.

Outputs

Output Parameter Description

Parameter	Type	Description
`InstEgy`	REAL	Instantaneous energy rate in kW. In order to be in line with the ODVA standards, the instantaneous energy value should not exceed 32767 kW.
`ThermalOutput`	ARRAY [0...4] OF INT	Instantaneous energy in local units.
`TotalEgy`	ARRAY [0...4] OF INT	Total energy consumed in Wh.
`LastEgySample`	ARRAY [0...4] OF INT	Energy consumed in the last sample time in Wh.
`Health`	BOOL	Indicates the health of the block: • `Health` = 0: Energy of the block not aggregated. • `Health` = 1: Energy of the block is aggregated.

Inputs/Outputs

Input/Output Parameter Description

Parameter	Type	Description
Data_ST	DATA_ST_DDT *(see page 60)*	This DDT pin is connected between the DFB and the Aggregator block, for aggregation of energy values.
Boiler_ST	STATUS_ST_DDT *(see page 60)*	This is the primary variable used for communication with the Vijeo Citect components.
Boiler_CFG	BOILER_CFG_DDT *(see page 61)*	This is the secondary variable used for communication with the Vijeo Citect components.

DATA_ST_DDT

This structure contains the data to be aggregated from the Boiler block. Refer to DATA_ST_DDT *(see page 20)*.

STATUS_ST_DDT

This structure contains the block control and status data:

Parameter	Type	Description
InstEgy	REAL	Instantaneous energy.
TotalEgyDint	DINT	Total energy in Wh. This is used for trend tags.
ThermalOutputDint	DINT	Total energy value in local units for trend tags.
LastEgySampleDint	DINT	Last energy values for the set sample time. This information is used for trend tags.
STW	WORD	Status word.
CFGW	WORD	Configuration word.

BOILER_CFG_DDT

This structure contains the additional status data:

Parameter	Type	Description
Temperature	REAL	Temperature of the steam input
Pressure	REAL	Pressure of the steam output
EnthalpyS	REAL	Enthalpy of steam
EnthalpyW	REAL	Enthalpy of water
MFR	REAL	Mass flow rate
SampleEgy	Array [0..4] OF INT	Sample energy
TotalEgy	Array [0..4] OF INT	Total energy
ThermOP	ARRAY [0..4] OF INT	Instantaneous thermal energy
ThermUnit	BYTE	The unit of the thermal energy derived in: ● 0 - kcal ● 1 - BTU ● 2 - Therms
Reserved	BYTE	Reserved

STW- Status Word

Bit Structure of STW - Status Word:

Bit	Description
0	Detected failure: ● 0 - No detected failure ● 1 - Detected failure
1	Energy type: ● 0 - Producer ● 1 - Consumer
2...15	Reserved

CFGW- Configuration Word

Bit Structure of CFGW - Configuration Word:

Bit	Description
0	Reset energy- Detected by level
1...15	Reserved

Public Variables

Public Variable Description

Variable	Type	Description
EnthalpyS	REAL	Enthalpy of steam in kcal/kg.
EnthalpyW	REAL	Enthalpy of water in kcal/kg.
ScanRate	TIME	Specify the time interval desired to perform energy aggregation.
SampleT	TIME	This public variable is the interval at which the totalized energy is updated.
Reset	UINT	Reset.
ResetEnable	BOOL	1 - Reset is enabled
EType	BOOL	Energy type of the object: ● 0 - Producer ● 1 - Consumer
TempUnit	BYTE	Unit of temperature measured in: ● 0 - Kelvin ● 1 - Celsius ● 2 - Fahrenheit
PressureUnit	BYTE	Unit of pressure measured in: ● 0 - bar ● 1 - Atm ● 2 - kPa ● 3 - kg/cm^2
MassFlowUnit	BYTE	Unit of mass flow rate measured in: ● 0 - kg/hr ● 1 - gm/hr ● 2 - tonne/hr
ThermalOutputUnit	BYTE	Thermal output unit measured in: ● 0 - kcal ● 1 - BTU ● 2 - Therms
SC	SEQ_SC_DDT *(see page 62)*	Provides the frequently needed data to monitor.

SEQ_SC_DDT

Provides the frequently needed data to monitor *(see page 32)*.

Chapter 7
Air Compressor DFB

Overview

This chapter describes the `AirCompressor` DFB.

The function block does not reflect any specific installation.

⚠ WARNING

MISAPPLICATION OF FUNCTION BLOCKS

Before adopting these function blocks for use in a specific application, you must:

- Conduct a safety analysis for the application and equipment installed.
- Verify that the selected function blocks are appropriate for the equipment or function in the installation.
- Supply appropriate parameters, particularly for limits.
- Check that all sensors and actuators are compatible with the selected function blocks.
- Verify that all functions of the selected function blocks work properly during verification and commissioning.
- Provide independent paths for critical control functions (emergency stop, over-limit conditions, etc.) according to the safety analysis and applicable codes, and regulations.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

What Is in This Chapter?

This chapter contains the following topics:

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DFB Representation	67
Inputs	68
Outputs	69
Inputs/Outputs	70
Public Variables	72

Overview

Working Principle

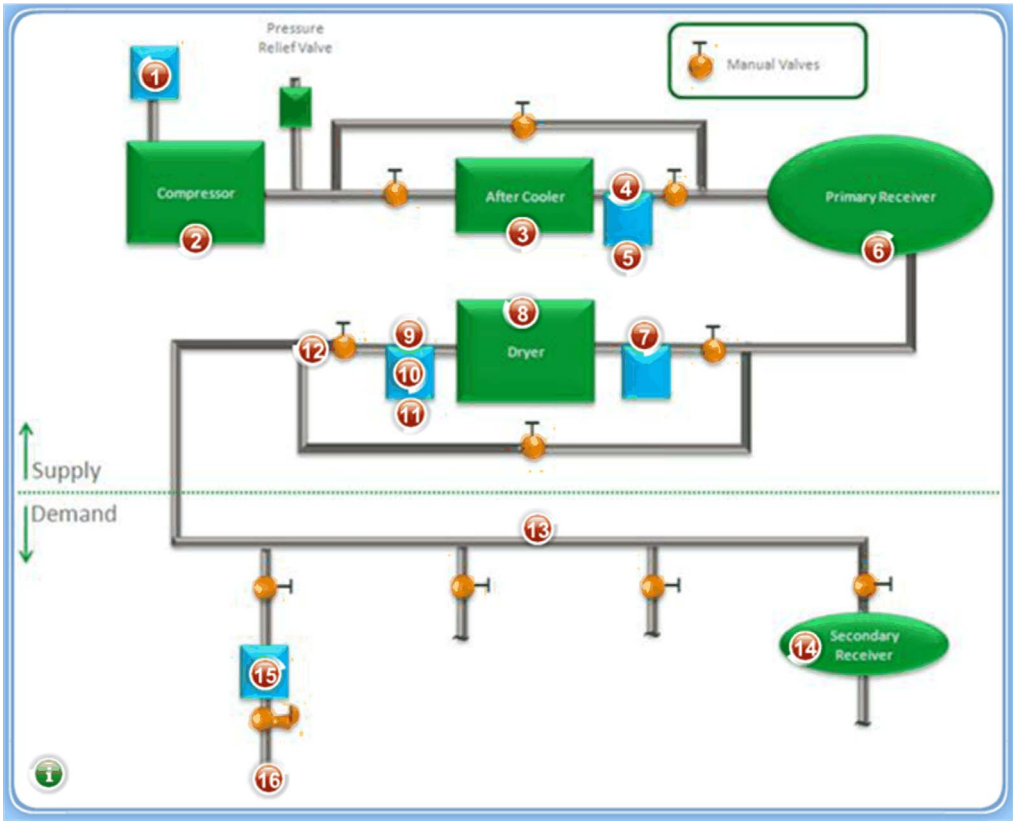
Air compressor system is a unit that converts power coming from an electric motor, diesel engine, or gas engine to kinetic energy by compressing and pressurizing air. This can be released to carry out the industry operation on demand.

The Air Compressor block is used to calculate the energy consumed by the air compressor to compress the air to a desired pressure. It takes input in the form of volumetric flow rate of air, desired pressure of the air, and power consumed by the air compressor to compress the air to the desired pressure.

The functions of Air Compressor block are as follows:

- This block totalizes the volume flow (volumetric flowmeter input) and gives it as output in the Odometer format.
- It gives the pressure to consumption ratio (pressure sensor input/ power consumption input).
- It also gives the ratio of volume flow to consumption (volumetric flowmeter input/ power consumption input)
- For input values, pressure and volume flow are first scaled through an analog input block and then is passed to the energy object.
- The threshold of these values is in the analog input itself, where these thresholds (high-high, high, low, and low-low) are available. These alert indications are shown in SCADA.
- You need to configure the respective units of these input parameters for appropriate conversion.

The following figure shows the components of air compressor system:



Components Of Air Compressor System

Component	Description
Intake air filters	Avoids dust from entering the compressor. Dust causes sticking valves, scoured cylinders, excessive wear, and so on.
Inter-stage coolers	Reduces the temperature of the air before it enters the next stage. This action reduces the work of compressor and increases efficiency. They are water-cooled.
After-coolers	Removes the moisture in the air by reducing the temperature in a water-cooled heat exchanger.
Air-dryers	Removes remaining traces of moisture in air using air dryers. As the air for instrument and pneumatic equipment has to be relatively free of any moisture. The moisture is removed by using absorbent such as silica gel/activated carbon, refrigerant dryers, or heat of compression dryers.

Component	Description
Moisture drain traps	Removes the moisture in the compressed air. These traps resemble steam traps. Various types of traps used are manual drain cocks which are timer-based or automatic drain valves.
Receivers	Stores and smoothens the pulsating air output, by reducing the pressure variations from the compressor.

Three basic types of air compressors are:

1. Reciprocating
2. Rotary screw
3. Rotary centrifugal

Air Compressor System with Regard to Energy Management Library

The energy library offer is generic and can be used for any type of compressor as only the working principle differs in these types.

Air compressor function in Energy Management library provides relational information to the plant operator in runtime, in two forms:

- Compressed air volume versus electrical consumption of the compressor unit over time.
- Compressed air pressure versus electrical consumption of the compressor unit over time.

Energy library has a function block named Air Compressor. This block collects the volume, air pressure, and power consumption data as input and calculates a relation between the compressed air volume to electrical consumption and compressed air pressure to electrical consumption over time. The function object acquires data in the following manner.

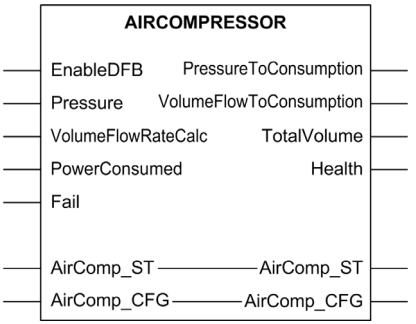
- The input parameters of this object include electrical power consumed to drive the compressor coming from the existing Electrical block.
- The input parameters also contain pins for pressure and volume flow. These parameters are measured from the field by flow meters and pressure transmitters.

The output derived from the block is accumulated information including the performance of the compressed air system with reference to volume and pressure and corresponding power consumed over a period defined by the user.

DFB Representation

Representation

The following figure represents the `AirCompressor` DFB:



Inputs

Input Parameter Description

Parameter	Type	Description
EnableDFB	BOOL	Enables the DFB.
Pressure	REAL	Pressure of compressed air
VolumeFlowRateCalc	REAL	The volume flow rate of the compressed air is being given out at the output side, measured using a flow meter.
PowerConsumed	REAL	The electrical power of the compressor is consumed and can come from the Electrical object.
Fail	BOOL	Any detected failure that is linked to this block. This input will come from a CONDSUM block.

Outputs

Output Parameter Description

Parameter	Type	Description
`PressureToConsumption`	REAL	Gives the ratio of the pressure of the compressed gas to the electrical energy consumed. This is an instantaneous value.
`VolumeFlowToConsumption`	REAL	Gives the ratio of the volume flow of the compressed gas to the electrical energy consumed. This is an instantaneous value.
`TotalVolume`	ARRAY [0..4] OF INT	Gives the total volume of air compressed since the running of the block.
`Health`	BOOL	Indicates the health of the block: • `Health` = 0: Energy of this block is not aggregated. • `Health` = 1: Energy of this block is aggregated.

Inputs/Outputs

Input/Output Parameter Description

Parameter	Type	Description
AirComp_ST	AIRCOMP_ST_DDT *(see page 70)*	This is the primary variable used for communication with the Vijeo Citect components.
AirComp_CFG	AIRCOMP_CFG_DDT *(see page 70)*	Additional data for Vijeo Citect components.

AIRCOMP_ST_DDT

This structure contains the block control and status data:

Parameter	Data Type	Description
PressureToCons	REAL	Pressure to consumption ratio.
STW	WORD	Status word.
CFGW	WORD	Configuration word.

AIRCOMP_CFG_DDT

This structure contains the additional status data:

Parameter	Data Type	Description
VolToCons	REAL	Volume to consumption ratio.
VolumeFlow	REAL	Volume flow of compressed air.
Pressure	REAL	Output pressure.
TotalVolume	ARRAY [0..4] OF INT	Total volume compressed.
Reserved	INT	Reserved

STW- Status Word

Bit Structure of STW - Status Word:

Bit	Description
0	Detected failure: ● 0 - No detected failure. ● 1 - Detected failure.
1...15	Reserved

CFGW- Configuration Word

Bit Structure of CFGW - Configuration Word:

Bit	Description
0	Reset total volume - Detected by level.
1...15	Reserved

Public Variables

Public Variable Description

Variable	Type	Description
ScanRate	TIME	Specify the time interval desired to perform energy aggregation.
Reset	UINT	Resets the value of total volume.
ResetEnable	BOOL	1 - Reset is enabled.
VolUnit	BYTE	Unit of volume flow: ● 0 - m3/hr ● 1 - cf/hr ● 2 - ccf/hr ● 3 - mcf/hr ● 4 - litres/hr
PresUnit	BYTE	Unit of pressure measured in: ● 0 - bar ● 1 - Atm ● 2 - kPa ● 3 - kg/cm^2
Reserved	INT	Reserved
SC	AIRCOMP_SC_DDT *(see page 72)*	Provides the frequently needed data to monitor.

AIRCOMP_SC_DDT

Provides the frequently needed data to monitor:

Parameter	Data Type	Description
PowToCons	REAL	Pressure to consumption ratio.
VolToCons	ARRAY [0..4] OF INT	Volume to consumption ratio.
Health	BOOL	Health status.
AHH	BOOL	High-high level alarm.
AH	BOOL	High-level alarm.
AD	BOOL	Deviation alarm.
AL	BOOL	Low level alarm.
ALL	BOOL	Low-low level alarm.
Reserved	BOOL	Reserved

Chapter 8
Liquid DFB

Overview

This chapter describes the `Liquid` DFB.

The function block does not reflect any specific installation.

⚠ WARNING

MISAPPLICATION OF FUNCTION BLOCKS

Before adopting these function blocks for use in a specific application, you must:

- Conduct a safety analysis for the application and equipment installed.
- Verify that the selected function blocks are appropriate for the equipment or function in the installation.
- Supply appropriate parameters, particularly for limits.
- Check that all sensors and actuators are compatible with the selected function blocks.
- Verify that all functions of the selected function blocks work properly during verification and commissioning.
- Provide independent paths for critical control functions (emergency stop, over-limit conditions, etc.) according to the safety analysis and applicable codes, and regulations.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

What Is in This Chapter?

This chapter contains the following topics:

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Inputs/Outputs	78
Public Variables	80

Overview

Description

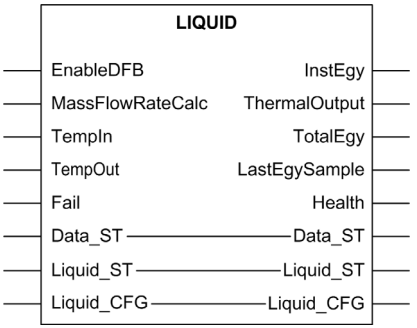
The functions of `Liquid` block are as follows:

- The Liquid object is used to calculate the energy consumed/produced by a liquid. It takes input in the form of mass flow rate of liquid with a specific heat value and the physical properties to provide an output, which can be used to determine the accumulation of energy in the form of consumption/generation.
- Specific heat is the constant entered by the user, hence a look up table could be made for different liquids. The calorific value of the liquid are to be entered from the public variable of the DFB.
- Liquid quantity is measured with mass flow meters.
- For input values such as mass and volume flow, pressure and temperature are first scaled through an analog input block and then is passed to the energy object.
- The threshold of these values are in the analog input itself, where these threshold (high-high, high, low, and low-low) are available. These alert indications are shown in SCADA.
- You need to configure the respective units of these input parameters for appropriate conversion.
- Mass flow meter gives the value in terms of mass flow rate (kg/hr). Amount of liquid (Energy Consumed) with regard to Mass flow is calculated as: Energy = Mass flowrate * Cp * dt = kcal/kg * kg/hr = kcal/hr => kWh.
- Totalized value at the set sample rate provides energy value at the output pin energy which is calculated using the following equation:
  Q = M * Cp * dt
  - Q = Energy or heat duty, kW
  - M = Mass kg/hr
  - Cp = Specific heat of water at operating conditions, kcal/kg° C
  - dt = Temperature difference

DFB Representation

Representation

The following figure represents the `Liquid` DFB:



Inputs

Input Pin Description

Parameter	Type	Description
EnableDFB	BOOL	Enables the DFB.
MassFlowRateCalc	REAL	Mass flow rate value of liquid is obtained from mass flow meter.
TempIn	REAL	Input temperature of water is obtained from temperature transmitter.
TempOut	REAL	Output temperature of water is obtained from temperature transmitter.
Fail	BOOL	Any detected failure that is linked to the block. This input will come from a CONDSUM block.

Outputs

Output Pin Description

Parameter	Type	Description
`InstEgy`	REAL	Instantaneous energy rate in kW. In order to be in line with the ODVA standards, the instantaneous energy value should not exceed 32767 kW.
`ThermalOutput`	ARRAY [0...4] OF INT	Instantaneous energy in local units.
`TotalEgy`	ARRAY [0...4] OF INT	Total energy consumed in kWh.
`LastEgySample`	ARRAY [0...4] OF INT	Energy consumed in the last sample time in kWh.
`Health`	BOOL	Indicates the health of the block: `Health` = 0: Energy of the block is not aggregated. `Health` = 1: Energy of the block is aggregated.

Inputs/Outputs

Input/Output Parameter Description

Parameter	Type	Description
Data_ST	DATA_ST_DDT *(see page 78)*	This DDT pin is connected between the DFB and the Aggregator block, for aggregation of energy values.
Liquid_ST	STATUS_ST_DDT *(see page 78)*	This is the primary variable used for communication with Vijeo Citect components.
Liquid_CFG	LIQUID_CFG_DDT *(see page 79)*	This is the secondary variable used for communication with Vijeo Citect components.

DATA_ST_DDT

This structure contains the data to be aggregated from the Liquid block. Refer to DATA_ST_DDT *(see page 20)*.

STATUS_ST_DDT

This structure contains the block control and status data:

Parameter	Type	Description
InstEgy	REAL	Instantaneous energy.
TotalEgyDint	DINT	Total energy in Wh. This is used for trend tags.
ThemalOutputDint	DINT	Total energy value in local units for trend tags.
LastEgySampleDint	DINT	Last energy values for the set sample time. This information is used for trend tags.
STW	WORD	Status word.
CFGW	WORD	Configuration word.

LIQUID_CFG_DDT

This structure contains additional status data:

Parameter	Type	Description
TempIn	REAL	Input temperature of liquid
TempOut	REAL	Output temperature of liquid
SpecificHeat	REAL	Specific heat of liquid
MFR	REAL	Massflow rate
SampleEgy	ARRAY [0..4] OF INT	Sample energy
ThermOP	ARRAY [0..4] OF INT	Instantaneous thermal energy
TotalEgy	ARRAY [0..4] OF INT	Total energy
ThermalUnit	BYTE	The unit of the thermal energy derived in: ● 0 - kcal ● 1 - BTU ● 2 - Therms
Reserved	INT	Reserved

STW- Status Word

Bit Structure of STW - Status Word:

Bit	Description
0	Detected failure: ● 0 - No detected failure ● 1 - Detected failure
1	Energy type: ● 0 - Producer ● 1 - Consumer
2...15	Reserved

CFGW- Configuration Word

Bit Structure of CFGW - Configuration Word:

Bit	Description
0	Reset energy - Detected by level
1...15	Reserved

Public Variables

Public Variable Description

Variable	Type	Description
SpecificHeat	REAL	Specific heat of the liquid in kcal/kgK.
ScanRate	TIME	Specify the time interval desired to perform energy aggregation.
SampleT	INT	This public variable is the interval at which the totalized energy is updated.
Reset	UINT	1 - Reset the totalized energy value.
ResetEnable	BOOL	Reset: 0 - Disabled 1 - Enabled
Etype	BOOL	Energy type: 0 - Block is producer 1 - Block is consumer
ThermalOutputUnit	BYTE	Unit of thermal energy derived in: 0 - kcal 1 - BTU 2 - Therms
TempUnit	BYTE	Unit of temperature measured in: 0 - Kelvin 1 - Celsius 2 - for degree Fahrenheit
MassFlowUnit	BYTE	Unit of mass flow rate being measured in: 0 - kg/hr 1 - gm/hr 2 - tonne/hr
Reserved	BYTE	Reserved
SC	SEQ_SC_DDT *(see page 80)*	Provides frequently needed data to monitor.

SEQ_SC_DDT

Provides the frequently needed data to monitor *(see page 32)*.

Chapter 9
Co2 DFB

Overview

This chapter describes the `Co2` DFB.

The function block does not reflect any specific installation.

⚠ WARNING

MISAPPLICATION OF FUNCTION BLOCKS

Before adopting these function blocks for use in a specific application, you must:

- Conduct a safety analysis for the application and equipment installed.
- Verify that the selected function blocks are appropriate for the equipment or function in the installation.
- Supply appropriate parameters, particularly for limits.
- Check that all sensors and actuators are compatible with the selected function blocks.
- Verify that all functions of the selected function blocks work properly during verification and commissioning.
- Provide independent paths for critical control functions (emergency stop, over-limit conditions, etc.) according to the safety analysis and applicable codes, and regulations.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

What Is in This Chapter?

This chapter contains the following topics:

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Overview

Description

Carbon dioxide equivalency is a quantity that describes, for a given mixture and amount of greenhouse gas, the amount of Co2 having the same global warming potential (GWP) when measured over a specified timescale (100 years).

Carbon dioxide equivalency reflects the time-integrated radiation forcing a quantity of emissions or rate of greenhouse gas emission.

A flow into the atmosphere before an instantaneous value of the radiation forcing the stock (concentration) of greenhouse gases in the atmosphere described by Co2e.

This block is designed to record the carbon equivalent of the energy being produced in a plant or site or equipment.

Carbon dioxide equivalent (CDE) and equivalent carbon dioxide (Co2e) are the 2 related, but distinct measures for describing global warming a type and may cause, greenhouse gas using the functionally equivalent amount or concentration of carbon dioxide(Co2) as the reference.

You have to enter this factor manually depending on:
- the user location
- the norms followed by the location
- fuel type used

This block has following 8 preconfigured carbon factor types:
- Grid electricity
- Natural gas
- LPG
- Gas oil
- Burning oil
- Diesel
- Petrol
- Industrial coal

If you want to give your own carbon factor, the provision has been given as well.

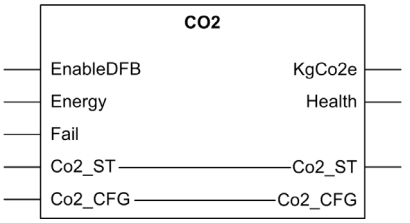
At the output side of the block, there is one output, which gives the kg equivalent of Co2. This value is obtained by multiplying this factor with the energy value.

The input is an instantaneous energy. This is multiplied by the equivalent carbon factor and is accumulated at every one second to get a totalized value.

DFB Representation

Representation

The following figure represents the Co2 DFB.



Inputs

Input Parameter Description

Parameter	Type	Description
EnableDFB	BOOL	Enables the DFB.
Energy	REAL	The energy input in kW.
Fail	BOOL	Any detected failure that is linked to the block. This input will come from a CONDSUM block.

Outputs

Output Parameter Description

Parameter	Type	Description
KgCO2e	REAL	The kg carbon dioxide equivalent.
Health	BOOL	Indicates the health of the block: • Health= 0: Energy of this block is not aggregated • Health= 1: Energy of this block is aggregated.

Inputs/Outputs

Input/Output Parameter Description

Parameter	Type	Description
Co2_ST	Co2_ST_DDT *(see page 86)*	This is the primary variable used for communication with Vijeo Citect components.
Co2_CFG	Co2_CFG_DDT *(see page 86)*	This is the secondary variable used for communication with Vijeo Citect components.

Co2_ST_DDT

This structure contains the block control and status data:

Parameter	Type	Description
STW	WORD	Status word.
CFGW	WORD	Configuration word.

Co2_CFG_DDT

This structure contains the additional status data:

Parameter	Type	Description
KgCo2e	REAL	Carbon equivalent in kg.
Energy	REAL	Instantaneous energy.
TotalEgy	REAL	Total energy.

Public Variables

Public Variable Description

You can enter the public parameters before running of the controller for proper calculations and aggregation.

Variable	Type	Description
CarbonFactor	REAL	User-defined carbon factor.
Reset	UINT	1 - Reset the totalized energy value.
ResetEnable	BOOL	Reset: 0 - Disabled 1 - Enabled
CarbonFactorType	BYTE	Type of energy consumed: ● 0 - Grid electricity ● 1 - Natural gas ● 2 - LPG ● 3 - Gas oil ● 4 - Fuel oil ● 5 - Burning oil ● 6 - Diesel ● 7 - Petrol ● 8 - Industrial coal ● 9 - User defined
SC	CO2_SC_DDT *(see page 87)*	Provides frequently data to monitor.

Co2_SC_DDT

Provides the frequently needed data to monitor:

Parameter	Type	Description
KgCo2e	REAL	Carbon equivalent in kg.
Health	BOOL	Health status.
Reserved	INT	Reserved.

Chapter 10
Process Energy DFB

Overview

This chapter describes the `ProcEnergy` DFB.

The function block does not reflect any specific installation.

⚠ WARNING

MISAPPLICATION OF FUNCTION BLOCKS

Before adopting these function blocks for use in a specific application, you must:

- Conduct a safety analysis for the application and equipment installed.
- Verify that the selected function blocks are appropriate for the equipment or function in the installation.
- Supply appropriate parameters, particularly for limits.
- Check that all sensors and actuators are compatible with the selected function blocks.
- Verify that all functions of the selected function blocks work properly during verification and commissioning.
- Provide independent paths for critical control functions (emergency stop, over-limit conditions, etc.) according to the safety analysis and applicable codes, and regulations.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

What Is in This Chapter?

This chapter contains the following topics:

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Inputs/Outputs	94
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Overview

Description

The `ProcEnergy` block is used to record the energy per production unit instantaneous value for a particular parameter that the user wants to monitor.

At the end of production shift, the `TotalEgy` output pin shows the amount of energy that has gone into this production.

Consider a situation where a reactor in which a certain substance, for example, milk is being fermented. The reactor will have a weight transmitter for the final production of the milk product monitoring the production (in kg, tonne), which will be connected to the `ProcEnergy` block product value pin for recording the instantaneous value.

The gas, electrical, solid fuel energy object values are collected in one aggregation block, the output of which will be connected to the `ProcEnergy` block Energy pin. The `ProcEnergy` block gives the instantaneous ratio of energy/ production unit of the particular process.

This block is that it gives the user the capability to model a desired energy. This curve consists of 3 straight lines. The parameters of these lines are to be entered by the user.

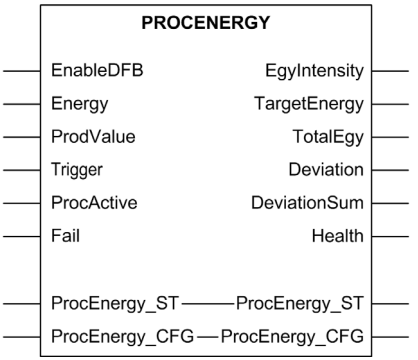
The user also has to write external logic which is to be connected to the `Trigger` input. This logic is to specify the termination of the shift. After the block gets the `Trigger` input in the form of pulsed input the block will compare the true energy or total energy for that shift with the model curve. It will then record the energy deviation between the curves.

The block will store 5 of these deviations in an array called `Deviation` output pin. The user also has to specify the Threshold deviation from HMI. If the total value of the last 5 deviations exceeds the threshold deviation, then a notification is generated. This will help the user to realize that there is an overconsumption of energy at that level of the plant, and the user can further make amendments.

DFB Representation

Representation

The following figure represents the `ProcEnergy` DFB.



Inputs

Input Parameter Description

Parameter	Type	Description
EnableDFB	BOOL	Enables the DFB.
Energy	REAL	The energy parameter coming from an accumulator which is recording the overall instantaneous energy being utilized for the production parameter.
ProdValue	REAL	The instantaneous production value. This can come from a weight transmitter of a reactor or any transmitter which is monitoring a production value.
Trigger	BOOL	The trigger input is to be a pulsed input to be given after the shift is over. This will reset the total energy and will give the energy deviation for that particular shift from the modeled energy.
ProcActive	BOOL	Takes the health of the Process that is being monitored. If the process is healthy the block requires an input of 1 and will calculate the energy values.
Fail	BOOL	Any detected failure that is linked to the block. This input will come from a CONDSUM Block

Outputs

Output Parameter Description

Parameter	Type	Description
`EnergyIntensity`	REAL	The energy consumed to produce a unit of product.
`TargetEnergy`	REAL	This is the energy that is modeled by user.
`TotalEnergy`	REAL	Total energy consumed for that shift. Gets reset as soon as the shift is changed through the trigger input.
`Deviation`	ARRAY [0...4] OF INT	This is an array, which contains the last 5 deviations from the last 5 shifts.
`DeviationSum`	REAL	Sum of last 5 deviations.
`Health`	BOOL	Indicates the health of the block. • `Health` = 0: Energy of the block is not aggregated. • `Health` = 1: Energy of the block is aggregated.

Inputs/Outputs

Input/Output Parameter Description

Parameter	Type	Description
ProcEnergy_ST	PROCENERGY_ST_DDT *(see page 94)*	The DDT is to pack and send data to HMI.
ProcEnergy_CFG	PROCENERGY_CFG_DDT *(see page 94)*	This DDT contains additional data for HMI.

ProcEnergy_ST_DDT

This structure contains the block control and status data:

Parameter	Type	Description
EnergyIntensity	REAL	Energy consumed per unit of production.
STW	WORD	Refer to Status word *(see page 95)*.
CFGW	WORD	Configuration word.

ProcEnergy_ST.STW

Bit Structure of STW - Status Word:

Bit	Description
0	Detected failure: ● 0 - No detected failure ● 1 - Detected failure
1	Deviation: ● 0 - Deviation OK ● 1 - Total deviation exceeds threshold value
2...15	Reserved

ProcEnergy_CFG_DDT

This structure contains the additional status data:

Parameter	Type	Description
TotalEgy	REAL	Total energy consumed between trigger periods.
ProdValue	REAL	Production value.
TotalDeviation	REAL	Total deviation.
LastDeviation	REAL	Last deviation.
Slope1	REAL	Slope of line 1.

Parameter	Type	Description
YInt1	REAL	Y intercept of line 1.
Slope2	REAL	Slope of line 2.
YInt2	REAL	Y intercept of line 2.
Slope3	REAL	Slope of line 3.
YInt3	REAL	Y intercept of line 3.
Slope4	REAL	Slope of line 4.
YInt4	REAL	Y intercept of line 4.
Slope5	REAL	Slope of line 5.
YInt5	REAL	Y intercept of line 5.
ThresholdDeviation	REAL	Threshold deviation.

STW- Status Word

Bit Structure of STW - Status Word:

Bit	Description
0	Detected failure: ● 0 - No detected failure ● 1 - Detected failure
1	Energy type ● 0 - Producer ● 1 - Consumer
2	Energy detected failure: ● 0 - No detected failure ● 1 - Detected failure
3...15	Reserved

CFGW- Configuration Word

Bit Structure of CFGW - Configuration Word:

Bit	Description
0	Reset energy - Detected by level.
1...15	Reserved

Public Variables

Public Variable Description

Variable	Type	Description
Reset	UINT	Resets the total energy, deviation, and deviation sum.
ResetEnable	BOOL	1 - reset is enabled.
Reserved	BOOL	Reserved
SC	PROCENERGY_SC_DDT *(see page 96)*	Provides frequently needed data to monitor

ProcEnergy_SC_DDT

This structure provides the frequently needed data to monitor:

Parameter	Type	Description
EnergyIntensity	REAL	Energy intensity.
DeviationSum	REAL	Total sum of last 5 deviations.
Health	BOOL	Health status.
AHH	BOOL	High-high level alarm.
AH	BOOL	High level alarm.
AD	BOOL	Deviation alarm.
AL	BOOL	Low level alarm.
ALL	BOOL	Low-low level alarm.
Reserved	INT	Reserved

Chapter 11
Advanced Process Energy DFB

Overview

This chapter describes the `ProcEnergyAdv` DFB.

The function block does not reflect any specific installation.

⚠ WARNING

MISAPPLICATION OF FUNCTION BLOCKS

Before adopting these function blocks for use in a specific application, you must:

- Conduct a safety analysis for the application and equipment installed.
- Verify that the selected function blocks are appropriate for the equipment or function in the installation.
- Supply appropriate parameters, particularly for limits.
- Check that all sensors and actuators are compatible with the selected function blocks.
- Verify that all functions of the selected function blocks work properly during verification and commissioning.
- Provide independent paths for critical control functions (emergency stop, over-limit conditions, etc.) according to the safety analysis and applicable codes, and regulations.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

What Is in This Chapter?

This chapter contains the following topics:

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Inputs/Outputs	102
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Overview

Description

The `ProcEnergyAdv` block is used to record the energy per production unit instantaneous value for a particular parameter that the user wishes to monitor.

At the end of production shift, the `TotalEnergy` output pin would show the amount of energy that has gone into this production.

Consider a situation where we have a reactor in which a certain substance, say milk is being fermented. The reactor will have a weight transmitter for the final production of the milk product monitoring the production (in kg, tonne), which will be connected to the `ProcEnergyAdv` block `ProdValue` pin for recording this value.

The gas, electrical, solid fuel energy objects values will be collected in one `Aggregator` block, the output of which will be connected to the `ProcEnergy` block Energy pin. The `ProcEnergy` block would thus give us the instantaneous ratio of Energy/ production unit of the particular process.

Another feature of this block is that it gives the user the capability to Model a desired energy curve. This curve will be consisted of three straight lines. The parameters of this line are to be entered by the user.

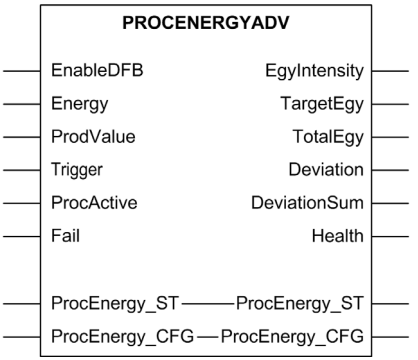
The user also has to write external logic which is to be connected to the trigger input. This logic is to specify the termination of the shift. Once the block gets the trigger input in the form of pulsed input the block will compare the true energy or total energy for that shift with the model curve. It will record the energy deviation between the curves.

The block will store 5 of these deviations in an array called Deviation output pin. The user also has to specify the Threshold deviation from HMI. If the total value of the Last 5 deviations exceeds the threshold deviation, then a notification is generated. This will help the user to realize that there is an overconsumption of energy at that level of the plant, and he can further make amendments.

DFB Representation

Representation

The following figure represents the `ProcEnergyAdv` DFB:



Inputs

Input Parameter Description

Parameter	Type	Description
EnableDFB	BOOL	Enables the DFB.
Energy	REAL	The energy parameter coming from an accumulator is recording the overall instantaneous energy being utilized for the production parameter.
ProdValue	REAL	The instantaneous production value. This can come from a weight transmitter of a reactor or any transmitter which is monitoring a production value.
Trigger	BOOL	The trigger input is to be a pulsed input to be given after the shift is over. This will reset the total energy and will give the energy deviation for that particular shift from the modeled energy.
ProcActive	BOOL	Takes the health of the Process that is being monitored. If the process is healthy the block requires an input of 1 and will calculate the energy values.
Fail	BOOL	Any detected failure that is linked to the block. This input will come from a CONDSUM Block.

Outputs

Output Parameter Description

Parameter	Type	Description
`EnergyIntensity`	REAL	The energy consumed to produce a unit of product.
`TargetEnergy`	REAL	This is the energy that is modeled by you.
`TotalEnergy`	REAL	Total energy consumed for that shift. Gets reset as soon as the shift is changed through the trigger input.
`Deviation`	ARRAY [0...4] OF INT	This is an array, which contains the last 5 deviations from the last 5 shifts.
`DeviationSum`	REAL	The sum of last 5 deviations between total energy and target energy.
`Health`	BOOL	Indicates the health of the block. ● `Health` = 0: Energy of the block is not aggregated. ● `Health` = 1: Energy of the block is aggregated.

Inputs/Outputs

Input/Output Parameter Description

Parameter	Type	Description
ProcEnergy_ST	PROCENERGY_ST_DDT *(see page 102)*	The DDT pin is to pack and send data to HMI
ProcEnergy_CFG	PROCENERGY_CFG_DDT *(see page 102)*	This DDT contains additional data for HMI

ProcEnergy_ST_DDT

This structure contains the block control and status data *(see page 94)*.

ProcEnergy_CFG_DDT

This structure contains the additional status data *(see page 94)*.

STW- Status Word

Bit Structure of STW - Status Word:

Bit	Description
0	Detected failure: ● 0 - No detected failure ● 1 - Detected failure
1	Energy type: ● 0 - Producer ● 1 - Consumer
2	Deviation: ● 0 - Deviation OK ● 1 - Total deviation exceeds threshold value
3...15	Reserved

CFGW- Configuration Word

Bit Structure of CFGW - Configuration Word:

Bit	Description
0	Reset energy - Detected by level
1...15	Reserved

Public Variables

Public Variable Description

Variable	Type	Description
Reset	UINT	Resets the total energy, deviation, and deviation sum.
ResetEnable	BOOL	1 - reset is enabled.
Reserved	BOOL	Reserved
SC	PROCENERGYADV_SC_DDT *(see page 103)*	Provides frequently needed data to monitor.

PROCENERGYADV_SC_DDT

Provides the frequently needed data to monitor. Refer to PROCENERGY_SC_DDT *(see page 96)*.

Chapter 12
Solid DFB

Overview

This chapter describes the `Solid` DFB.

The function block does not reflect any specific installation.

⚠ WARNING

MISAPPLICATION OF FUNCTION BLOCKS

Before adopting these function blocks for use in a specific application, you must:

- Conduct a safety analysis for the application and equipment installed.
- Verify that the selected function blocks are appropriate for the equipment or function in the installation.
- Supply appropriate parameters, particularly for limits.
- Check that all sensors and actuators are compatible with the selected function blocks.
- Verify that all functions of the selected function blocks work properly during verification and commissioning.
- Provide independent paths for critical control functions (emergency stop, over-limit conditions, etc.) according to the safety analysis and applicable codes, and regulations.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

What Is in This Chapter?

This chapter contains the following topics:

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Overview

Description

Solid fuel refers to various types of solid material that are used as fuel to produce energy and provide heating, released through combustion. Solid fuels include wood, charcoal, peat, coal, Hexamine fuel tablets, and pellets made from wood, corn, wheat, rye, and other grains.

This block provides the energy content of a solid fuel, which is used in any process or equipment.

You have to connect the parameters, which will provide the mass flow rate of the fuel along with the calorific value of the fuel being used.

The formula used to calculate the Energy is:

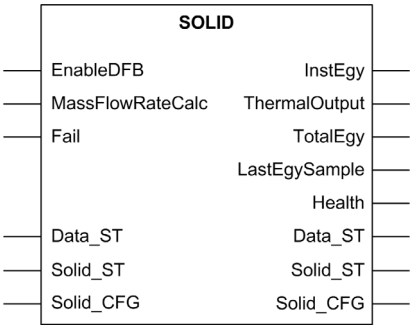
Energy = (Mass flow rate x Calorific value of fuel)

- For input values such as mass and volume flow, pressure and temperature are first scaled through an analog input block and then, is passed to the Energy object.
- The threshold of these values are done in the analog input itself, where these thresholds (high-high, high, low, and low-low) are available. These alert indications are shown in SCADA.

DFB Representation

Representation

The following figure represents the `Solid` DFB:



Inputs

Input Parameter Description

Parameter	Type	Description
EnableDFB	REAL	Enables the DFB.
MassFlowRateCalc	REAL	Mass flow rate of the fuel being fed into the process through a meter.
Fail	BOOL	Any detected failure that is linked to the block. This input will come from a CONDSUM Block.

Outputs

Output Parameter Description

Parameter	Type	Description
`InstEgy`	REAL	Instantaneous energy rate in kW. In order to be in line with the ODVA standards, the instantaneous energy value should not exceed 32767 kW.
`ThermalOutput`	ARRAY [0...4] OF INT	Instantaneous energy in local units.
`TotalEgy`	ARRAY [0...4] OF INT	Total energy consumed in kWh.
`LastEgySample`	ARRAY [0...4] OF INT	Energy consumed in the last sample time in kWh.
`Health`	BOOL	Indicates the health of the block. ● `Health` = 0: Energy of the block is not aggregated. ● `Health` = 1: Energy of the block is aggregated.

Inputs/Outputs

Input/Output Parameter Description

Parameter	Type	Description
Data_ST	DATA_ST_DDT *(see page 110)*	This DDT pin is connected between the DFB and the Aggregator block, for aggregation of energy values.
Solid_ST	STATUS_ST_DDT *(see page 110)*	This is the primary variable used for communication with the Vijeo Citect components.
Solid_CFG	SOLID_CFG_DDT *(see page 111)*	This is the secondary variable used for communication with the Vijeo Citect components.

DATA_ST_DDT

This structure contains the data to be aggregated from the Solid block. Refer to DATA_ST_DDT *(see page 20)*.

STATUS_ST_DDT

This structure contains the block control and status data:

Parameter	Type	Description
InstEgy	REAL	Instantaneous energy.
TotalEgyDint	DINT	Total energy in Wh. This is used for trend tags.
ThermalOutputDint	DINT	Total energy value in local units for trend tags.
LastEgySampleDint	DINT	Last energy values for the set sample time. This information is used for trend tags.
STW	WORD	Status word.
CFGW	WORD	Configuration word.

SOLID_CFG_DDT

This structure contains additional status data:

Parameter	Type	Description
CalorificValue	REAL	Calorific value of solid fuel.
MFR	REAL	Massflow rate.
SampleEgy	ARRAY [0..4] OF INT	Sample energy.
TotalEgy	ARRAY [0..4] OF INT	Total energy.
ThermOP	ARRAY [0..4] OF INT	Instantaneous thermal energy.
ThermUnit	BYTE	The unit of the thermal energy derived in: ● 0 - kcal ● 1 - BTU ● 2 - Therms
Reserved	BYTE	Reserved

STW- Status Word

Bit Structure of STW - Status Word:

Bit	Description
0	Detected failure: ● 0 - No detected failure ● 1 - Detected failure
1	Energy type: ● 0 - Producer ● 1 - Consumer
2...15	Reserved

CFGW- Configuration Word

Bit Structure of CFGW - Configuration Word:

Bit	Description
0	Reset energy - Detected by level.
1...15	Reserved

Public Variables

Public Variable Description

Variable	Type	Description
CalorificValue	REAL	Value of calorific value in kcal/kg.
ScanRate	TIME	Specifies the time interval desired to perform energy aggregation.
SampleT	TIME	This public variable is the interval at which the totalized energy is updated.
Reset	UINT	Reset
ResetEnable	BOOL	1 - Reset is enabled.
Etype	BOOL	Energy type: 0 - Object is producer. 1- Object is consumer.
ThermalOutputUnit	BYTE	Unit of the thermal output measured in: 0 - kcal 1 - BTU 2 - Therms
MassFlowUnit	BYTE	Unit of the mass flow rate measured in: 1 - kg/hr 2 - gm/hr 3 - tonne/hr
SC	SEQ_SC_DDT *(see page 112)*	Provides frequently needed data to monitor.

SEQ_SC_DDT

Provides the frequently needed data to monitor *(see page 32)*.